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ADAPTING A SHORT-BELLOWS, ROLL-FILM KODAK FOR DETAIL WORK IN THE FIELD

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Most geologists, when in the field, have occasionally felt the need of a portable camera with which they might take large-size detail photographs. The ordinary equipment for such work, the long-draw, box camera, is far too heavy and bulky to be carried by the geologist as a part of his daily accoutrement. The roll-film kodak with the customary short bellows which is most convenient for his usual needs, fails when he wishes a picture larger than about one-tenth natural size, and the auxiliary portrait lens does not greatly increase the scope of his outfit. If he wishes a detail picture of a fossil in place, a curious marking or texture of a rock which cannot be conveniently sent to his headquarters, he must note the place and come again later with the more bulky equipment. He almost never does.

The device described below has been found by the writer to be a simple and convenient solution of the problem. An auxiliary portrait lens was first secured to fit the kodak he wished to use. This attachment consists of a simple plano-convex lens of about 52-inch focus. When placed close in front of the kodak lens this causes parallel beams of light to become slightly convergent when they strike the main lens system and thus shortens the focus of the combination (See Fig. 1, Scale II). With the principal focus now somewhat nearer the ground glass, the slight additional excess of bellows-length permits focusing on closer objects and hence larger pictures than with the kodak lens only.

Next, there were procured from an optician two more lenses of foci approximately 16 inches and 8 inches respectively. These were ground to the proper diameter to fit the cell belonging to the original auxiliary. The three lenses are readily interchangeable by unscrewing the ring which holds in place the lens used. By using the two additional lenses, one at a time, the focus of the combination is further reduced, as shown in Scales III and IV of Figure 1. With the three used successively, the entire range of object-distance from infinity to less than eight inches can be accommodated, using only the two inches adjacent to the bellows-limit for adjustment.

After obtaining the lenses, the several combinations were calibrated for different distances by focusing on a ground glass placed in the image-plane and the readings made on a white celluloid metric scale which was attached to the bed, as shown in Figure 2. From these data were constructed the tables I and II which were photo-reduced and pasted in place on the bed of the kodak as shown. Here they are out of the way, but always convenient. Table I shows the setting on the metric scale for different object-distances, the three parts of the table referring, respectively, to the three auxiliary lenses, I, II, and III. Table II gives the object-distances for different ratios of object to image. For example, suppose one

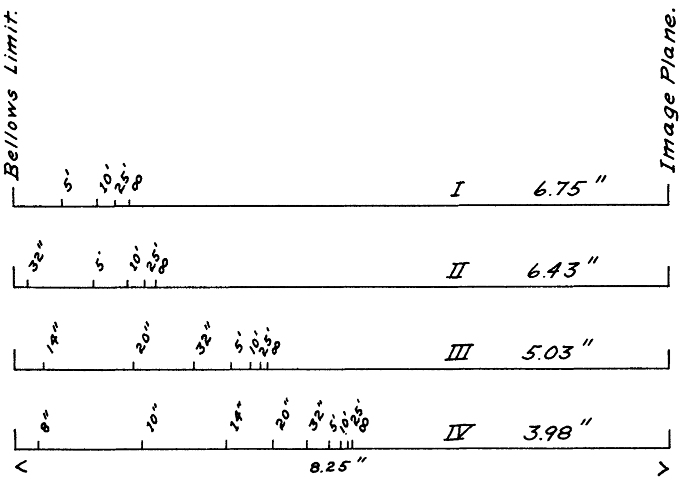

FIG. 1.—Diagram showing four focusing scales in relation to the image-plane and bellows-limit as follows: Scale I, with kodak lens of 6.75-inch focus; Scale II, using 52-inch focus auxiliary lens; Scale III, using 16-inch focus auxiliary lens; Scale IV, using 8-inch focus auxiliary lens. The figures at the right show the foci of the several combinations and the diagram shows clearly the increase in scope of the bellows as the auxiliaries of shorter focus are added.

wishes a picture which is one-half natural size. In Table II opposite the ratio 2 is given the object-distance 15 inches. Then in Table I, interpolating between 14 inches and 15 inches, we find that the focus should be at the scale-reading of 10.85 and that auxiliary lens II should be used. The kodak is then set with the lens 15 inches from the object to be photographed. Table II gives also at the bottom the foci of the three combinations, the focus of the kodak lens alone being about 6.75 inches.

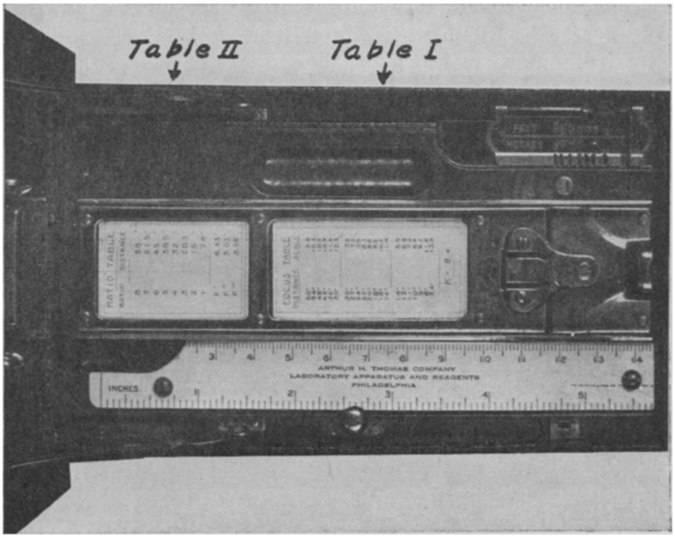

FIG. 2.—Photograph of bed of kodak showing attached metric scale and two tables as described in the text. (Somewhat reduced.)

The celluloid scale may, if desired, be so set as to read inches of focus from the ground glass directly; that shown was set arbitrarily and the readings indicate position only. With this device, sharp and undistorted photographs up to natural size may be taken by using a tripod or one of the numerous types of clamp support, and an aperture of F/32 or smaller. Since in pictures of this kind where the object is not plane, it is almost always necessary to reduce the aperture and give a time exposure in order to get depth of focus, there is no additional difficulty due to the auxiliary lens. Instantaneous pictures at full aperture may be made if need be, but the distance must be estimated with considerable accuracy to secure good definition. Such rapid exposures are rarely necessary or even desirable in the case of geologic subjects.

Anyone desiring to use this device will find that auxiliary lenses of 52-inch, 16-inch, and 8-inch foci will be a suitable series for a 3A kodak having a lens of about 6.75-inch focus. For the use of others with different kodaks, the following formula is given:

$$\frac{1}{F_{0+1}}=\left(\frac{1}{F_0}+\frac{1}{F_1}\right)1.08$$

where F_0 = focus of kodak lens, F_1 = focus of auxiliary lens, and F_{0+1} = focus of the combination. This formula is only approximate but is sufficiently accurate to guide one in the selection of a series of auxiliary lenses. These lenses can be secured from any well-equipped optician who does his own grinding. They should then be calibrated by focusing on a ground glass in the image-plane and taking readings on the scale. Tables can then be constructed, as shown in Figure 2.

The extra lenses can be carried in any convenient pill-box. The cost for the three lenses and cell is less than five dollars and the outfit has been found by the writer during two seasons' field work to give highly satisfactory results.